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Industrial Manufacturing Management Data

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Comments to Reader

Industrial Automation Systems and Integration -
Industrial Manufacturing Management Data -
Resource Usage Management
Part 31: Overview and fundamental Principles

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Contents

Foreword

ISO (the International ~~Organization~~Organisation for ~~Standardization~~Standardisation) is a ~~worldwide~~world-wide federation of national standards bodies (member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International ~~organizations~~organisations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical ~~standardization~~standardisation.

Draft International Standards (DIS) adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 67% approval by the member bodies voting.

International Standard ISO 15531-31:1997(E) "Industrial Automation Systems and Integration - Industrial Manufacturing Management Data -Resource usage Management" was prepared by ISO Technical Committee ISO/TC 184 *Industrial automation systems and integration* Sub-Committee 4 *Industrial Data*

ISO 15531-3's series consists of the following Parts:

~~ISO 15531-~~ – Part 31 : Overview and fundamental principles

~~ISO 15531-~~ – Part 32 : Conceptual model for resources usage management data

~~ISO 15531-~~ – Part 33 : ~~ISO~~ Conformance testing

Introduction

Resources form the basis and ~~longterm~~ technological foundation ~~potential~~ of any manufacturing system. The efficient use of resources is the main goal of cost management ~~that~~ which, in turn, directly contributes to market success.

~~Following the viewpoint from which we look at the resource, some d~~Different aspects of the resources depend on the viewpoint ~~can~~ being considered. The choice of a specific aspect is a way of reducing complexity.

Therefore, future concepts for business process development and resource management require:

- an integrated view of the ~~entire~~ complete set of business processes and the relevant resource management activities,
- an integrated resource management including interfaces to external manufacturing unit, suppliers, etc.

Resource attributes such as ~~capabilities~~capability, capacity, ~~entry means,~~ etc. and the required capabilities and ~~capacity~~ capacities ~~coming from the~~for manufacturing processes have to be described by data modeling, so that they can be communicated and used more efficiently for resource usage management ~~efficiently~~. The means of information representation should therefore be standardized.

In this standard the only aspect under consideration is the usage management of resources.
The objective is to describe the resource management information to enable an unhindered flow of information between all systems and humans involved.

Industrial automation systems
Industrial manufacturing management data
Resource Usage Management
Part 31: Overview and fundamental Principles

1 Scope

1.1 Scope of ISO 15531-30's series

The scope is to develop the models, ~~form~~ and attributes ~~able to~~capable of ~~reside~~ residing in an industrial manufacturing company's resource database which are to be used by manufacturing management for the purpose of resource usage management.

The following are within the scope of ISO 15531-3's series:

- ~~*~~The representation of resources information including capacity, monitoring, maintenance constraints and control
- ~~*~~The exchange and sharing of resource~~s~~ information including storing, transferring, accessing and archiving.

The following are outside the scope of ISO 15531-3's series:

- Enterprise ~~modeling~~modelling
  tools, architecture and methodologies for the ~~modeling~~modelling of the whole enterprise
- Product Data
  representation and exchange of product information
- Component Data (Parts Library)
  representation and exchange of computer-interpretable parts library information
- Cutting Tools
  Electronic representation for exchange of cutting tool data
- Technical Maintenance Information
  Technical information such as those included in devices repair, operation and maintenance manuals

This part of ISO 15531-3's series gives an overview of this International Standard and of the main principles used.~~.~~

~~.~~

1.2 Scope of ISO 15531-31

The following are within in the scope of this Part 31 of ISO 15531:

- general overview of the parts 15531-3's series and of the main principles used,

- structure of the standard and relationships between the three series of parts the standard is
- ~~made of~~composed.
- definitions of terms used.
- fundamental principles used for conceptual model of resource usage management data (~~Informative~~informative)
- derivation process of identification and description of resources (informative).
- use of standard (informative)

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards

ISO 10303-1: 1993, *Industrial automation systems and integration- Product data representation and exchange - Part 1: Overview and Fundamental Principles*

ISO 10303-11: 1994, *Product data representation and exchange - Part 11: Description methods: The EXPRESS language reference manual*

ISO/IEC 8824-1:1994, *Information Technology - Open Systems Interconnection - Abstract Syntax Notation One (ASN.1) Part 1: Specification of Basic Notation.*

ISO/IEC 2382-24:1995, *Information technology - Vocabulary - Part 24: Computer-integrated manufacturing.*

ISO 13584-1:1997, *Industrial automation systems and integration - Parts library - Overview and fundamental principles*.

ISO 10303-21: 1995, *Product Data Representation and Exchange - Part 21: Clear text encoding of the exchange structure.*

ISO 10303-22: 1995, *Product Data Representation and Exchange - Part 22: Standard data access interface.*

ISO 10303-31:1994, *Product Data Representation and Exchange - Part 31: General Concepts*

ISO 10303-41: 1994, *Product Data Representation and Exchange - Part 41: Fundamentals of product description and support.*

ISO 10303-49: 1997, *Product Data Representation and Exchange - Part 49: Process structure and properties.*

3 Definitions

For the purposes of this part of ISO 15531, the following definition apply.

3.1 Attribute

An attribute is a piece of information stating a property of an entity.

3.2 Business Process

A partially ordered set of ~~Enterprise a~~Activities of the entire enterprise which can be executed to realize a given objective of an enterprise or a part of an enterprise to achieve some desired end-result.

3.3 Capability

The quality of being able ~~or endued for~~to ~~executing~~ execute an activity.

3.4 Capacity

The ~~productive~~ amount of ~~the~~ output ~~of~~ a manufacturing system is capable of producing.

3.5 Classification

The process of arranging abstractions into a structure ~~organized~~organised according to their distinguishing properties.

3.6 Conformance Testing

The testing of a candidate product for the existence of specific characteristics required by a standard in order to determine the extent to which that product is a conforming implementation.

3.~~6~~7 Construct

A textual or graphical ~~artefact~~artifact devised to represent in an orderly way the diverse information on common properties and elements of a collection of phenomena.

3.~~7~~8 Entity

A class of objects which have common properties.

3.~~8~~9 Model

The explicit expression of one's understanding of a system or situation. It can be expressed in mathematics, symbols or words, but it is essentially a description of entities and the connectivity between them.

3.~~9~~ 10 Object

A concept or a physical thing which may exist in the real world

3.~~10~~ 11 Operation

The completion of an action or work element to realize a specific result.

3.~~10~~12 Order

A construct which represents the necessary input for a Business Process that coordinates and controls some other Business Process or Activity.

3.~~11~~ 13 Process

A particular method of doing something generally involving a number of steps or operations.

3.~~11~~14 Product

A construct which represents the desired output or by-product of the manufacturing processes of an enterprise, providing all information required for its fabrication or characterization. An object or substance produced by a natural or artificial process.

3.~~12~~ 15 Property

A real world characteristic which is represented by either attributes or constraints.

3.~~12~~16 Resource

Something that can be described in terms of behaviour, a capability, or a performance measure. A ~~a~~ny device, tool ~~and~~ or means (including human) which represents some or all capabilities required for the execution of a business process or an activity at the disposal of the enterprise to produce goods or services.

4 Overview (Parts 15531-3's series)

~~Those~~ This series of Parts refers to the resource usage management, such as resource configuration and capabilities, operation management of manufacturing devices, installation and facilities. They also include quality features, maintenance features (regarding the availability) and safety features.

Three different aspects must be considered about the resources :

- their description, ~~the way of using~~their usage and ~~maintaining them~~their maintenance,
- the description of the functionality a resource is able to ~~give~~provide, its capacity and capability,
- the information model used to trigger, estimate and monitor the resource.

~~Those~~ This series of parts ~~do~~ clearly do not address the first item ~~either~~ whether it be raw material or intermediate product.

The description of capacities, and capabilities of the resources (the functionality) must be ~~modeled~~modelled at a very generic level, allowing some "companion standards" to use this generic model to make up a more precise resource~~s~~ model aimed at a specific industrial activity, or a specific function.

~~Those~~ This series of parts of the standard deal with model, ~~form~~ and attributes of data ~~able to be~~capable of being stored in an industrial company's resource database~~, to be used for~~ for the purpose of manufacturing management. They address the following data:

- performance metrics;
- input and output resources definition;
- capacity and capability;
- tools and application software needed~~,~~ in ~~relation~~ conjunction with specific ~~activity~~activities;
- capacity of internal controls and intelligence;
- information input and output capability and capacity;
- standard references for resources;
- maintenance scheduling and monitoring;
- cost elements.

5 Structure of ISO 15531-3’s series

Manufacturing Resource Usage Management Data (ISO 15531-3’s series) is divided into ~~four~~ three parts. Although they are strongly connected and related, ~~those~~ this series of parts address specific concerns and are developed separately. A general overview provides principles and concepts to preserve consistency and to describe the relationships between them.

The numbering of the standard is the following:

ISO 15531-31 : Overview and fundamental principles
ISO 15531-32 : Conceptual model for resources usage management data
ISO 15531-33 : Conformance testing

~~The three parts of the standards are in close relationship.~~ Some of the information to be represented in the standard comes from the environment (suppliers, customers, subsidiaries,..) of the enterprise (ISO 15531-2's), and ~~then it spreades over the whole~~ is used throughout the entire production cycle to be ultimately ~~exchanged again with~~returned to the environment. In any case, data ~~exchanges~~ exchanged during the production cycle are strongly related to ~~the~~ system management and to ~~the~~ time and flow models (ISO 15531-40's). Part 31 describes the fundamental principles and gives ~~the~~ an overview of the 15531-3’s series. Part 32 describes the conceptual model for resource usage management data based on a special modelling concept and constructs and provides a resource information model (RIM). Part 33 describes the conformance testing procedure and results ~~to get~~.

6 Fundamental principles

The conceptual model of resource management is a way for modeling resource management activities and the ~~required~~ information required to perform these activities. Its objective is to provide a method for describing the usage management of resources in business processes and ~~the needed~~all related information.

~~To perform The task of~~ Planning and managing resources ~~relates to any kind of~~relating business process ~~the~~ to resource usage management requires

- a representation of the information needed by the business process
- a representation of the information about management activities necessary for planning and controlling the resources
- a representation of the resource information and attributes.

~~Related to this requirements the~~ Conceptual models of resource usage management ~~shall contain~~require:

- the modeling elements (resources, e.g. machines, information, etc.)
- the modeling of information needed for processes and information about the processes required for performing the resource management activities.

The following ~~chapters~~ sections describe ~~modelling~~modeling concepts and constructs to represent these requirements and ~~gives~~ provide an outline of the structure and elements of a resource information model ~~enabling~~ which enable resource usage management.

6.1 ~~Modelling~~Modeling Concept and Constructs

The representation of manufacturing business processes and ~~it's~~ corresponding complex structures in a model requires a modeling language which adequately ~~representing~~ represents the information, attributes, structures and processes needed for resource management.

A~~ny~~ business activity is a purpose-driven change of one or more objects. ~~Driven by determined purposes the activities~~These changes require direct or indirect planning and scheduling and ~~they~~ are executed by resources ~~owning~~ which own the needed capability.
~~The things to be~~Objects which are transformed by a resource are objects of the generic classes product (Product Development, Production,...), Order (Order Processing, Order Decomposition,...), Resource (Resource Planning, Resource Management, Maintenance,..) or their respective subclasses. ~~The~~ Ordering and controlling ~~of~~ resources is done by an order, electronic software or human control.
The ~~needed~~ enabling information ~~that enables the~~for a resource to execute the transformation is part of the resource description [1].
~~The~~ Each resource within a business process can be considered in the following manner (**figure 1**):

- The first section is the description of the object(s) (material or information, orders, products or other resources) to be transformed within the resource.
- The second section describes the transformation during which the task itself is achieved.
- The third section is of the description of the object(s), which have been transformed by the resource.

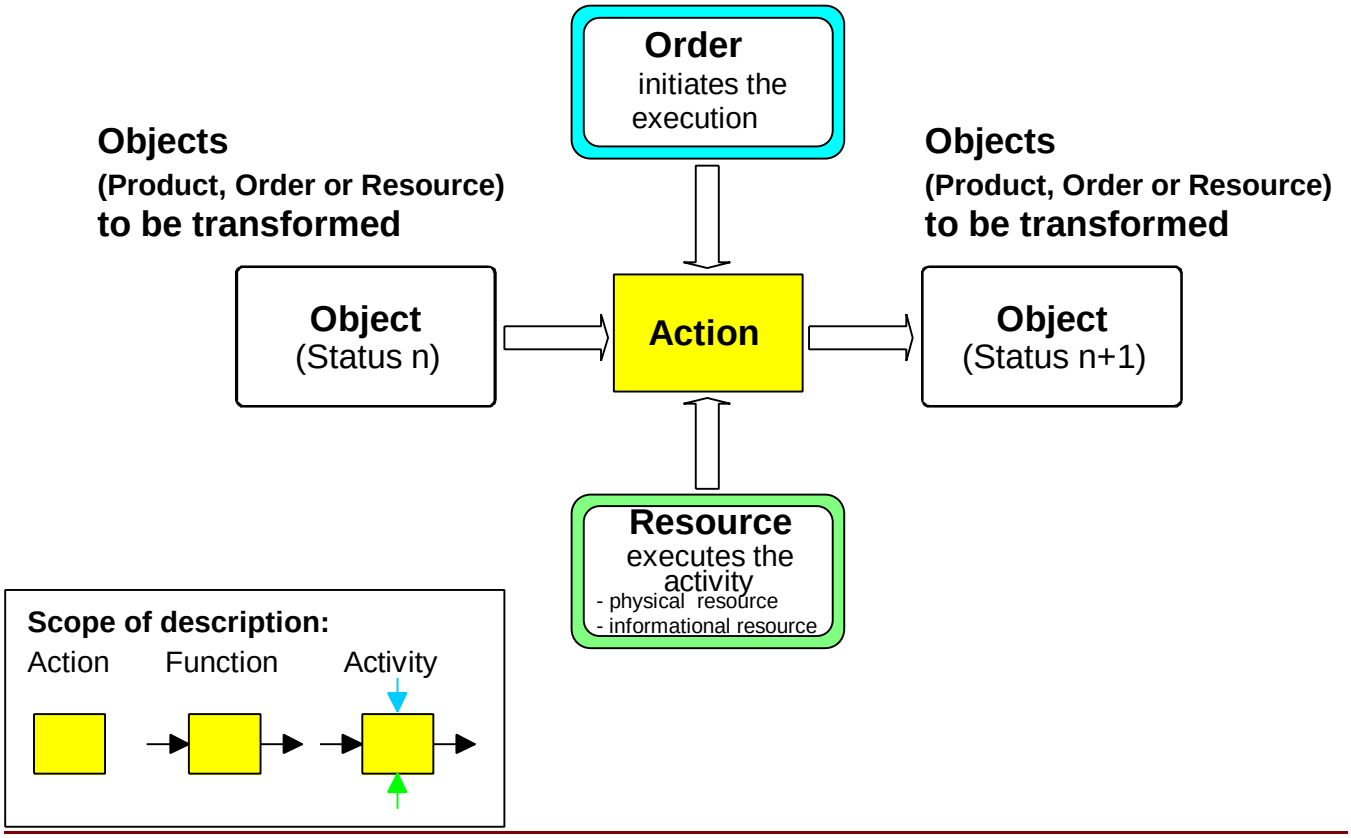

Figure 1 ¾ Model for representation of business processes and structures[1]

6.2 Object and Resource Change State Sections

6.2.1 Input Section

Objects ~~entering the owning resource~~ are subject to constraints prior to transformation. The input section, before transformation occurs, defines the format of object entries.

Note Usually there ~~are~~ is more than one possibility accepted by the resource and, as a result, the definition of the constraints and attributes will be a list or a generic definition.

6.2.2 Transformation Section

This section ~~is representing~~ represents the transformation capabilities and the capacity the resource is able to provide to the outside.

6.2.3 Output Section

Objects ~~leaving the resource to the outside~~released from the resource are also subject to ~~have to respect some~~ constraints. The output section relate~~d~~s transformed ~~to~~ objects ~~transformed~~ is defining under which form and with which support, the objects have to leave the resource (see 6.2.1 Input Section)

Representing the related and affected processes of resource usage management with the above described concept and constructs leads to the elements of a Resource Information Model enabling and supporting resource usage management.

6.3 Resource Information Model (RIM)

A complete representation of manufacturing resources, e.g. shape aspects, is not within scope of the standard [ISO15531-32]. Only data relevant for decision making regarding to the usage of resources, e.g. within process planning or job scheduling, are considered. In order to meet all tasks, the information model is structured in a modular way (Fig. 2).
The entity *resource* forms the central element within the schema. Each further description classifying or detailing a resource's characteristics is related to *resource*. The schema's entities can be clustered into logical units representing :

- Resource hierarchy ;
- structure of resource characteristics ;
- resource status ;
- definition of resource views ;
- definition of resource characteristics and
- resource configuration.

A resource hierarchy can be represented by ~~instanciating~~instantiating *resource_group* and *generic_resource* which are both subtypes of *resource*. The recursive attribute *super_group* to *resource_group* enables the representation of multiple hierarchical layers of resources, e.g. a classification of cutting tools regarding to ISO 13399. A *generic_resource* is characterised by a complete definition of all related attributes, but without link to actual values. The instances of *generic_resource* form the lowest level in a resource hierarchy. A *specific_resource* is the specification of a *generic_resource*, which is derived by assigning actual values to all resource-related attributes except attributes related to tasks which require dynamic information. An *individual_resource* represents physical available manufacturing resources and enables a relation to dynamic information. The *individual_resource* inherits all attributes respectively values from the relating *specific_resource*.

For resource usage management purposes a *resource_characteristic* is appointed which comprises information about the actual *resource_status*. The attribute *classification* enables the assignment of a *resource_characteristic* to a *resource_characteristic_group*, distinguishing into :

- *resource_administration* ;
- *resource_capability* ;
- *resource_constitution* and
- *resource_capacity*.

A *resource_administration* represents a group of characteristics describing administrative information on manufacturing resources. A *resource_capability* defines a group of characteristics specifying manufacturing resources under functional aspects. In particular this comprises the specification of resource-specific manufacturing processes. A *resource_constitution* represents a group of characteristics describing the constitution of manufacturing resources. A *resource_capacity* defines a group of characteristics dealing with job scheduling related resource data, e.g. the workload of an *individual_resource*.
A definition of a *resource_view* is derived by a specific aggregation of *resource_characteristics*. A *resource_view* is assigned to a *generic_resource* and can either be represented by a *resource_tabular_layout_of_article_characteristics*, e.g. regarding to DIN 4000, or by a *resource_user_defined_view*].

Representing a resource hierarchy and defining a resource view form the first ~~instanciation~~instantiation level of the generic model. A partial model has to be derived in order to configure the model regarding to user-specific demands. It is generated by ~~instanciating~~instantiating *resource_group* and *generic_resource*, including the definition of a *resource_view*. The actual ~~instanciation~~instantiation of the model with physical resource data is based on the partial model. Physical values of manufacturing resource characteristics are represented by *resource_representation* which can either be qualitative or quantitative values.
A *resource_status* is assigned to each *individual_resource*. A status is defined by a *resource_status_type* which provides feedback information on the state of manufacturing resources. Moreover a *resource_status* has a *time_reference* to *date* which is represented in the *date_time_schema* of STEP PART 41 [ISO10303-41].

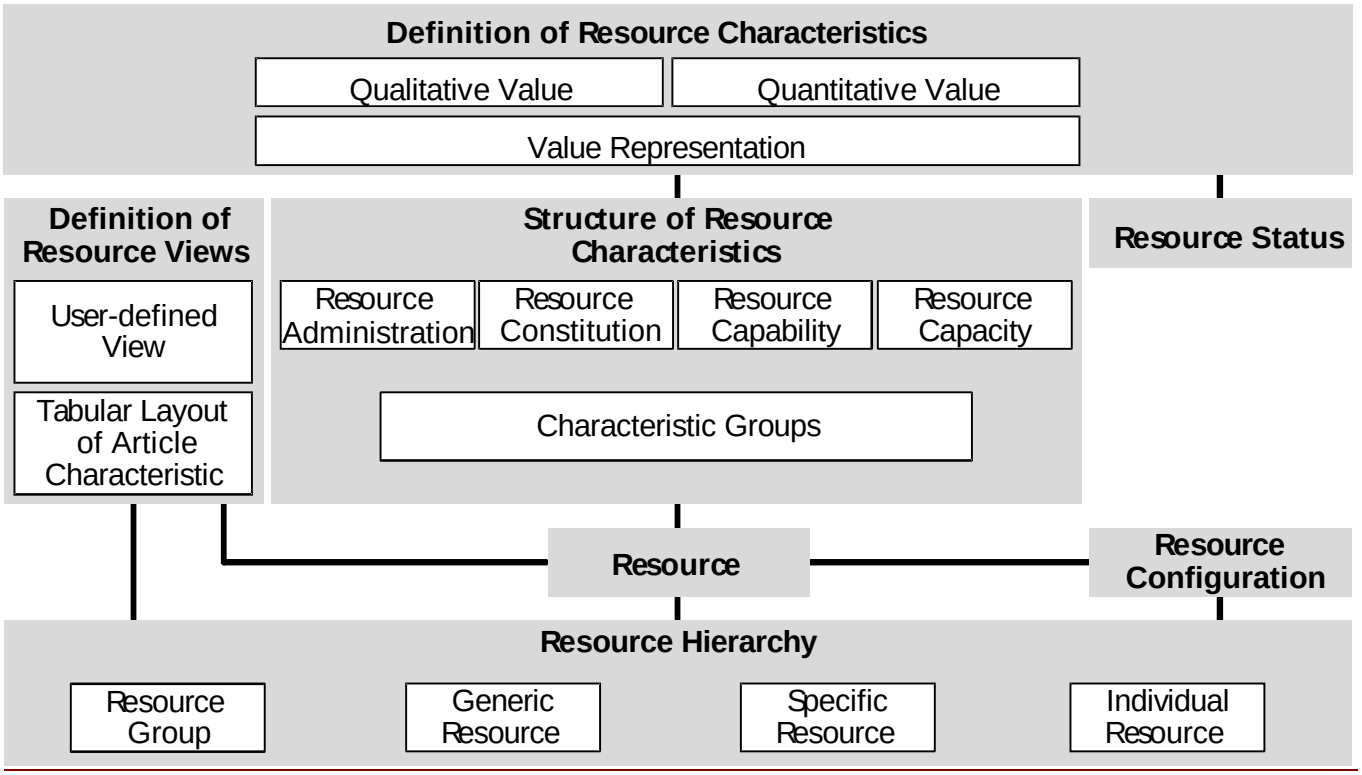

Figure 2 ¾ Structure of Resource Information Model [2]

7 Relation to ISO 15531-2’s series and ISO 15531-4’s series

Some of the information to be represented in the ISO 15531-30’s series comes from the environment (suppliers, customers, subsidiaries,..) of the enterprise (ISO 15531-20's) and ~~are~~ is linked to ~~the~~ information represented ~~e.g.~~ in Resource Characteristics.

Data exchanges ~~-~~during the production cycle are strongly related to ~~the~~ system management and to ~~the~~ time and flow models (ISO~~(~~ 15531-40's). Direct linkages from the Resource Information Model (ISO 15531-32) to resource status and time schemas in ISO 15531-40’s are established.

In that way, information on internal system management (ISO 15531-40's), resources usage management (ISO 15531-3's) and information to be exchanged outside of the company (ISO 15531-20's), even if they are ~~modeled~~modelled in a separate way, ~~have to~~~~should~~will be fully consistent.

8 Relation to other standards (Informative)

Appropriate related standards as well as ~~standardization~~standardisation efforts will be considered in this standard, ~~among which~~and include STEP (ISO 10303), P-LIB (ISO 13584), EDIFACT, MMS, and standards or efforts dealing with enterprise ~~modeling~~modelling (ISO CD 14258, CEN ENV 40003, CEN ENV 12204~~, W~~. Also included is work in progress within the ISO TC184/SC5/WG1 and CEN TC310/WG1), as well as other related ~~standardization~~standardisation work (i.e. work in progress in the ISO TC29/WG34 on "Cutting tools" data exchange). ~~The formalisms developed in~~ ISO 15531-31 will ~~have to~~ support ~~these interactions~~this related work.

During ~~the~~ manufacturing processes, people use data defined by the designers, and they do not have to ~~re-do the~~redefine work already done. Raw material, or intermediate products, clearly product-related, are within the scope of ISO 10303. ~~They are then~~These items are out of the scope of ISO 15531-3's series. ~~On the same way s~~Some data about components ~~have~~ has to be exchanged during the production process inside the factory and/or outside the factory (i.e. through the purchasing department). ~~They belong to~~This is within the scope of ISO 13584. Moreover ~~a lot of~~many other kinds of data, which are defined in other ~~standardization~~standardisation group (i.e. work done in
ISO TC29/WG24 on "Cutting Tools", ISO 13399 Cutting tool representation and exchange,
ISO TC184 SC1 WG7, ISO 14649 Data model for CNC controllers
are used, shared or exchanged during the production process inside the company.

~~Then t~~The models, constructs and data representations provided by 15531-3's series should be consistent with those provided by STEP (ISO 10303) and P-LIB (ISO 13584) in order to make integration in manufacturing easier and to ensure interoperability all over the production process. ~~That~~ This means, in particular, that ~~those~~ standards using EXPRESS language, have to be fully compliant with the STEP (ISO 10303) architecture.

Moreover, Resource Usage Management will be one of the tools of the manufacturing integration process~~, it should also have to~~and will be compliant with upper level integration tools such as those developed in the field of Enterprise ~~Modeling~~Modelling by the ISO TC184/SC5/WG1 (ISO 14258, ENV 12204).

~~Nevertheless, point of view of~~Specific portions of the 15531-30's series could be different from that adopted in ~~those~~ other standards. 15531-3's series could use other or new Integrated Resources which ~~they~~ are required for the optimal description of information and processes. ~~Then, even though duplication of work should be avoided, some~~Re-evaluation of the related information ~~has to be reconsidered and sometimes represented in a specific way, or with additional properties~~may become necessary~~.~~, ~~F~~for example:

- ~~–~~The PARTS list~~:~~, the designer ~~writes them~~creates a parts list to define the composition of assemblies. Most of the time, ~~they~~ parts lists are re-built by the manufacturing management. This is due to the ~~fact that the designer has a~~ top-down approach of the design function, from the whole product to assemblies and spare parts, while ~~production~~ manufacturing management has a bottom-up ~~point of view, because of its interest in~~approach, based on production in pulled flow~~, for~~ which takes a given level of inventories and resources availability into account.

- ~~–~~The PROCESS PLAN is a specific way to use ISO 10303 to define products ~~ISO10303s of the~~undergoing transformation during manufacturing. The link with the product to be made (thus with ISO 10303) is obvious (see ISO 10303-49). ~~However,~~ ~~a~~Available resources and tools, and their capabilities and capacities are ~~also strongly concerned and that is why this item is~~integrally linked and therefore common to both activities.

Except for very specific cases of prototypes, or unique parts, most of the data used during manufacturing cannot be defined at the product design stage, because ~~they are~~the data is determined by situations evolving with time, and also by variable characteristics and capabilities~~: thus the needs are not the same~~.

~~Since~~ ISO 10303, and ISO 15531-3's series ~~considers common~~assesses items common to both in ~~a~~ different ways and from ~~a~~ different viewpoints.~~,~~ ~~as well as~~As a result, the ISO 15531-3's ~~series~~ series,~~and~~ Enterprise ~~Modeling~~Modelling standards ~~or ISO 15531-3's series~~ and ISO TC29 standards ~~there is no~~do not overlap~~ping~~. There is ~~nevertheless~~ a very strong relationship between ~~those~~ these ~~standardization~~standardisation efforts and a need ~~of a very~~for close ~~coordination~~co-ordination ~~between the different developments to avoid duplication of work~~.

~~Especially there are t~~The following are specific references and relationships:
ISO 13399 can be used for ~~initiation~~ the initial parts of ISO 15531-32,
ISO 10303 (AP 213 and AP 224) could reference entities of ISO 15531-32,
ISO 14649 could reference to ISO 15531-32 entities.

9 Use of the standard (informative)

This standard will pay special attention to the description of the Resource Usage Management, and the configuration of resources.~~,~~ ~~s~~Selection of resource ~~activity~~ activities would use the data which are described by the data modeling method presented by this standard. The Resource Manager has to be supplied ~~by~~ with all necessary information at ~~any~~ all times to fulfill ~~his~~ its tasks. The standard is ~~done allowing to get~~allows access to this information under a standardized form independent of the kind of resources or processes..

The above described model ~~as~~ serves as a basis for a standard but is shown in only two dimensions. It corresponds to only one aspect, ~~which is the~~ Resource Usage Management. ~~It is useful to have the same kind of standard but dedicated other aspects, for instance, cost elements, maintenance, quality, etc.~~ By building ~~such~~ a generic schema dedicated to specific viewpoints such as cost elements, maintenance, and quality, a specialized set of application oriented standards or application protocols can be developed.

10 Bibliography

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